Results of Competition: Future Flight Challenge Phase 2: Strand 1, Fast Track Development

Competition Code: 2004_ISCF_MMM_FUTUREFLIGHTCHALLENGE_FULLSTAGE_FASTTRACK_STR1

Total available funding is £34,000,000 over 2 strands

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
ADJSOFT LIMITED	Project Rise	£331,042	£231,729
Cranfield University		£84,949	£84,949
SKY-DRONES TECHNOLOGIES LTD		£83,491	£58,444

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants

The use of drones is becoming more ubiquitous on a global scale with the widespread adoption of drone technology across countless industries and impacting upon people's everyday lives. The level of growth and adoption of drone technology in the UK suggests that there are many positive and significant benefits to their use. The recent Covid-19 pandemic highlights one of the best use cases in drones being used for good.

However, the drone industry is reaching its next major challenge. We've reached a systems regulatory ceiling that is becoming the main barrier to allowing to the industry advance and flourish. There are several challenges inhibiting the operating and integrating UAS into the wider airspace including sense and avoid technologies, lack of overall view on a system of systems approach, regulatory framework and UTM.

Dronecloud currently plays a significant role in the industry in with the comprehensive Flight Management System (FMS). UAS companies around the world are using Dronecloud to manage every aspect of their operation, from flight planning and compliance, Airspace checking through UT API feeds, flight logging and fleet management. However, current systems are built for today's regulatory environment. We see the need to develop such FMS systems that are capable to deliver the future of BVLOS and autonomous flight. Dronecloud are perfectly positioned to deliver Project Rise.

Taking these factors into consideration, Project Rise's core objective is to develop and demonstrate a scalable 'open standards API' based integration platform which can be become part of a 'proto system of systems'. The integration platform can be considered as a Flight Management System (FMS) that functions as a hub, integrating all elements of a drone operational workflow. Integrational influencers include UAS operators, UTM Service Providers and services, ATM service providers and services, CAA, Supplementary data service providers, public users and the UAS. The FMS will provide full operational functionality including flight planning, flight noticeboard, flight discovery, airspace authorisations, dynamic restrictions management, conflict management services, electronic identification, auditability, flight termination, accident and incident reporting and digital flight logging.

The drone industry is still new and developing at pace and in many cases in isolation from other commercially competing to gain advantage. Development of new technologies is also creating bespoke solutions to integrating, UAS, telemetry, Ground Control Stations and UTM, further creating barriers to widespread integration. A key consideration of Project Rise will be interoperability. From the outset we've set a core objective to develop open standards and open API definitions whose data and functions are made visible and usable to the wider UAS industry.

We will develop a system and demonstrate its functionality through delivery use case flight tests focusing on UTM Level 1 (BVLOS, <400ft, <20kg, E-ID, nominal and emergency scenarios).

In light of the recently launched Connected Places Catapult Paper, Enabling UTM in the UK, we're adopting the Open-Access UTM Framework guiding principles, which will help enable a level of coordination both within our own project and across the many different projects within the Future Flight Challenge.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
DRONE DEFENCE SERVICES LTD	Edged sensing array affording Intelligent integrated airspace awareness	£378,531	£264,972
University of Nottingham		£87,329	£87,329

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Project description - provided by applicants
Drones are set to transform industries of all types by optimising processes and reducing the cost of e.g. logistics and surveillance to near £zero. However, methods capable of tracking and increasing drone visibility need to be developed before commercial drones gain mainstream and legislative acceptance around our towns and cities, safely amongst people. Drone Defence herein aim to prove the technical feasibility of detecting the characteristic signatures from both legal and rogue drones through innovative sensor, and data processing methods. Our approach will enable autonomous drone tracking and a quick-response system capable of opening the 'motorways in the sky' through increased critical airspace visibility and awareness.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
NEOPTERA AERO LTD	Dock to Dock (D2D) Hydrogen eVTOL Freight Transportation	£183,003	£128,102
Cardiff University		£16,594	£16,594
SMART PORTS LTD		£186,503	£130,552
University of the West of England		£59,283	£59,283

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Dock-to-Dock ("D2D") is a pilot project focused on the combined aspects of route development, vehicle performance (air & sea) and the associated infrastructure ("Smart-Multiports"). These basics are necessary for the point-to-point delivery of goods and freight between coastal cities using zero emission Hydrogen fuel technology for eVTOL aircraft (electric Vertical Take-Off and Landing) and eAZE ships (electric Autonomous Zero Emission). Neoptera Aero Ltd, Smart Ports Ltd, Cardiff University and the University of the West of England, Bristol are developing the concept of Smart-Multiports (SMP) and D2D applications with the Hydrogen ("H2") ground infrastructure required, initially for the transport of freight/cargo of up to 500kg by eVTOL, to operate between Avonmouth Docks, Bristol and Cardiff Docks, Wales. D2D will demonstrate a commercially competitive alternative to ground transportation between coastal cities, with the use of unmanned winged eVTOL for the fast transport of high value goods. The transportation of bulky and less time-sensitive goods will be in eAZE ships. D2D will offload the already saturated ground transportation network between ports such as Swansea, Cardiff, Bristol and Bridgewater. With further development, D2D and its SMP infrastructure could be a major supplier of Green H2 to Bristol, Cardiff and Swansea airports, as commercial aircraft designers such as Airbus and Roll Royce race to develop Hydrogen-powered sub-regional aircraft. This infrastructure will encompass the entire System of Systems for autonomous air and marine operations between ports. The objective of D2D is to repurpose port infrastructures to be an essential component of future Smart Cities in their drive towards zero emissions and energy efficient, integrated and sustainable transportation solutions. Focusing upon a specific route development that already has infrastructure associated with maritime trade, D2D can address specific vehicle parameters and the ground-based infrastructure for H2 air and marine refuelling. 40% of the world's population lives within 60mile of the coast, with the average population density in coastal areas about twice the world's average population density, and 14 of the world's 17 largest cities are on coasts. As population density and economic activity in coastal zone increases, so does pressures on land-based transport systems. There are 120 commercial seaports in the UK representing 10% of all EU ports. The UK has 296 small-to-large size airports of which 40 handle commercial carriers. Comparatively, the EU has 4,649 small & medium airports. Presently, there are only 11 commercial Hydrogen Refuelling Stations (HRS) in the UK, and none West of Swindon, with only one experimental HRS in Wales at Baglan, run by University of South Wales. The EU already has 177 public HRS's, with another 43 in immediate construction. Germany, France, Italy, Norway and Spain are allotting significant financial and R&D resources to the development and use of Hydrogen in their efforts to meet climate change goals and zero emissions. Critically, many more HRS are urgently needed if the UK is to meet its zero emissions targets through the production and use of Hydrogen in heating, industry, power generation and transport. The D2D project and development of the SMP infrastructure will bring access to HRS in the South West of England and Wales. This project, in conjunction with initiatives lead by the Welsh Government, Western-Gateway Powerhouse, WECA and various West of England & Wales Green Hydrogen production sources (Nuclear, Tidal, Offshore wind, and biomass), will facilitate the UK to export its know-how around the world.

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DGP INTELSIUS LIMITED	INMED - Enabling Infrastructure for Medical Drone Deliveries	£101,442	£71,009
BLUE BEAR SYSTEMS RESEARCH LTD		£99,964	£69,975
Cranfield University		£83,496	£83,496
HEROTECH8 LTD		£93,424	£65,397
King's College London		£10,838	£10,838
Milton Keynes NHS Foundation Trust Hospital		£4,906	£4,906
THE DRONE OFFICE LTD		£72,450	£50,715

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Project description - provided by applicants
This project aims to pave a way for integration of drones into the UK transport system for their widespread use for commercial deliveries. For this purpose, we focus on development and integration of physical and digital infrastructure into the practice of medical supplies delivery between blood banks and UK hospitals, paying special attention on integration of the drone operations into medical operational practices. The project aims to propose a total solution for the delivery of medical drones, comprising a low-maintenance launch platform for drones with integrated automatic recharging, a drone with a temperature-controlled housing, which is approved and compliant for the medical transport of blood/blood products, operating procedures and a management application. The drone loading, take-off, landing and unloading will be demonstrated in the project at the Milton Keynes University Hospital site, while the flight from the blood bank to the hospital will be simulated for analysis of risks and development of risk mitigation measures related to airspace management, communication, and navigation. During the project, we plan a number of outreach activities, covering, in particular, medical organizations and aiming to demonstrate project outcomes, including demo flight videos, developed procedures and their integration in the tablet/smartphone app. Stakeholders and end users interviews will be undertaken to promote public acceptance of the drone deliveries, identify needs of the end users and new use cases that should be considered for the future developments. The project benefits from strategic governance of the Advisory Board that includes South Africa National Blood Service currently experimenting blood unit delivery by drone, Milton Keynes City Council, Oxford Blood Transfusion Centre and Patient Representative at Milton Keynes Hospital.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
CYBERVECTOR LIMITED	Establishing safe autonomous and radio controlled near-ground flight by dynamically mapping the combined aerodynamic and electromagnetic risks in complex physical environments and urban canyons	£328,015	£229,610
ZENOTECH LTD		£171,000	£119,700

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Project description - provided by applicants
Working in partnership, CyberVector Ltd and Zenotech Ltd have created a concept for a risk monitoring and assessment system for use by authorities, insurers, operators and other stakeholders to facilitate the safe and effective use of unmanned drones and other flying vehicles, in complex environments such as the Urban Canyon between the skyscrapers of modern cities. To implement this a first step of evaluating the feasibility of the concept has been proposed. A small team of highly experienced aerodynamic and electromagnetic experts intend to establish the feasibility of a practical system that could form the basis for a dynamically updated Air Traffic Management or Unmanned Traffic Management service, which would form the basis for safe and efficient Future Flight services, including transition to ground. CyberVector Ltd has expertise in systems engineering, electromagnetic technologies, data fusion, machine learning and project management, while Zenotech Ltd has expertise in aerodynamics, aero-acoustics, meteorology and fluid-dynamics. Stakeholders, such as Flochcover insurance underwriters and TRL transportation experts, have also been consulted with a view to ensuring the concept proposed in the feasibility study is fit for purpose, and experts from the University of Birmingham will provide any additional scientific advice.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
ZENOTECH LTD	SafeZone: A dynamic safe zone system for autonomous urban flight	£225,519	£157,863
FLARE BRIGHT LTD		£271,840	£190,288

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Project description - provided by applicants
High-tech SMEs Zenotech and FlareBright are working to deliver safer and more effective UAVs for use in urban environments via a new aerodynamic data service. SafeZone combines high fidelity air flow simulation for the built environment from Zenotech, with in-situ validation from the FlareBright nano drone SnapShot. This world-first project is supported by Innovate UK as part of the Future Flight programme, as well as the Welsh Government via the direct involvement of Cardiff Airport and Saint Athan Airport as live test sites for the project demonstration campaigns. Heathrow Airport have also confirmed interest in the technology development programme. Zenotech develops cloud high-performance computing and computational fluid dynamics technology for the aerospace, automotive, civil and renewable energy sectors. Zenotech delivers simulation securely at scale for organisations of all sizes offering faster, more accurate and cost-effective solutions by exploiting the latest hardware for power and efficiency. From acoustics capacity and noise reduction in aircraft to the optimisation of wind turbines, Zenotech's tools and technical consultancy are designed to enhance business performance and improve sustainability. SafeZone makes use of two of Zenotech's existing products: zCFD is a cost-effective, efficient, scalable computational fluid dynamics (CFD) solver bridging the gap between commercial and open source. This innovative, pay-on demand tool delivers high fidelity, unlimited CFD, offering an easier route to coupling multi-disciplinary capabilities and integrating third-party data sources. EPIC connects end users to a global range of cloud high performance computing resources from multiple back-end suppliers. EPIC enables access to unlimited resources on a pay as you go model without capital expenditure. EPIC can initiate and scale jobs anywhere in minutes, as a simple submission interface to specialist supercomputing resources or a tool to quickly and easily launch HPC clusters in the cloud. FlareBright is a UK-based Small Business who were winners of Phase 1 of Future Flight, and have been an active participant in Future Flight and aerospace forums. The company has six employees, and all are leading experts in their fields with decades of experience, supported by numerous advisors and supporters. FlareBright has raised over £100,000 of equity funding during the height of the Covid-19 crisis in April and May 2020, which complements £350,000 the founders have invested in this business. FlareBright has created machine learning, fully autonomous, flight-control software, with implementation in small fixed wing gliding drones. The software autonomously controls flight without utilising GPS or any electromagnetic (radio / microwave etc) communications. Four products / projects stem from the same machine learning software base: 1. An image capture nano drone, SnapShot 2. A precision-guided aerial delivery drone 3. A fail-safe emergency drone guidance system when GPS and any other communication links fail 4. Simulation expertise, manifesting as consultancy and Test and Evaluation products SnapShot is an image capture nano drone (85 grams weight) which autonomously returns to its user following a 100m altitude loop flight at the single touch

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of a button, which this project is adapting for use as a wind data sensor and collector. The customer need is for the simplest, smallest, lightest and most cost-effective way of obtaining this data set, so the idea is that anyone can have this in their pocket for immediate deployment and in a safe and controlled manner during a 10 to 20 second flight. SnapShot has been tested in winds of over 30 knots and is expected to perform well in even stronger winds.

FlareBright has excellent market traction as demonstrated by competitions won, letters of support and interest from leading Tier 1 aerospace and defence companies.

The partners are delighted to be working together on advanced data service systems for next-generation Future Flight.

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SLINK-TECH LTD	DigitalEYE - Next Generation Ground System for Future Flight Operations	£349,878	£244,915
University of Bristol		£149,625	£149,625

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Project description - provided by applicants
DigitalEYE is a next-generation ground control system developed by SLiNK-TECH which will enable high capacity future flight operations. It will provide critical landing zone situational awareness for mixed use airspace, with integrated UAM and drone/UAS operations. We will ensure safe operations through digital observation, connectivity and monitoring for deployment of air vehicles in temporary or permanent landing sites. DigitalEYE is being developed to meet the needs of a wide range of mixed-air operations including Urban Air Mobility (UAM) and UAS/drone operations. When deployed, the system will enable situational awareness for varied uses cases. The project is aimed at lowering the barrier to entry for businesses needing to add mixed-air operations to their offerings. For this FFC Strand 1 Project, SLiNK-TECH will partner with the University of Bristol (UoB) Flight Lab to provide a proof of concept demonstration for the integrated DigitalEYE system. The rapid development program will conduct a series of live trials at the Bristol Robotics Laboratory & UoB Fenswood Outdoor Flight Facility. We will prove the technology concept and lay the groundwork for future industry collaborations both through the Future Flight Challenge and in external partnerships. SLiNK-TECH's DigitalEYE is a vital key enabler of high capacity future flight operations. This FFC Strand 1 Project will provide the data and key systems integration required to partner with larger scale operators in future FFC projects and external industrial initiatives. Air vehicle ingress, egress and ground operations is a high-risk element for flight operations, and DigitalEYE is a vital component of ensure smooth and safe transition to mixed use of high-density air space operations.

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H2GO POWER LTD	HyStYRIAA 2.0 - Hydrogen Storage to Energise Robotics in Air Applications 2.0	£310,595	£217,416
Imperial College London		£132,935	£132,935

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Project description - provided by applicants
This project aims to develop a novel energy system that extracts clean electrical energy from low-pressure hydrogen carriers along with automation to realise the benefits of extended flight times (3x than typical Li-ion batteries) on existing UAVs. The project plan is to develop a medium-sized power system for a UAV (\\\>20Kg) and demonstrate a scalable technology and is based on a successful 1st generation system that was tested on a flight (HyStYRIAA 1) in 2019\. Unlike highly pressurised hydrogen gas which has limiting safety constraints in aerospace applications, that can only be stored effectively in cylindrical vessels and have prohibitive form factors. Low pressure hydrogen carriers have attributes similar to traditional aircraft fuels as it can be stored in a similar way (optimisation of existing volumes and structures). The differentiation with this technology is that the hydrogen needs to be extracted from the carrier before conversion to energy. Our technology can be scaled for large aircraft and could ultimately be a contender to electrify a significant proportion of worldwide flights with zero-emission implications. This project will focus on optimising the technology on a medium scale in the first instance and learning from implementation will be used for large scale applications at the post market entry stage. The technology proposed is a safe & efficient hydrogen storage reactor supported by balance-of-system that can efficiently store and release hydrogen for use in a fuel cell with great control at optimal rates. The development will concentrate on optimising existing H2GO technology that was successfully demonstrated on a flight pilot. This concept can be achieved through an iterative loop of simulation, design, and test where we demonstrate a system that is with competitive gravimetric densities (\\\>5wt% system at ambient pressures) that are safe and suitable for integration into other systems for commercial applications. Electric flight that has the potential for long durations has yet to be attained. A successful result of this project will be the feasibility demonstration of a novel system for carbon emission-free electric flight. This will lead to significant improvements of existing electric flight capabilities through longer flight times and more autonomy. This, in turn, will develop the autonomous air vehicles market for hydrogen-powered drones for commercial applications.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
WINDRACERS LIMITED	Swarm technology and digital twinning to enable coordination and utilisation of high numbers of 100kg payload UAVs in aid delivery and firefighting applications	£117,782	£82,447
DISTRIBUTED AVIONICS LIMITED		£232,152	£162,506
University of Bristol		£149,865	£149,865

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Unmanned aerial vehicles (UAVs) have the potential to become a reality for civil applications such as the transport of goods, aid delivery, or firefighting. The ULTRA unmanned aerial vehicle (UAV) developed by Windracers is currently being tested to transport COVID-19 medical supplies to the Isle of Wight for example. It is a large, double engine, fix winged, drone with a carrying capacity of up to 100kg, making it a unique platform in the UAV market. For UAV solutions to scale, providers will need to deploy swarms that operate in large numbers, up to 100s. Swarm solutions build on the ability of UAVs to react to their local environment and neighbouring UAVs without having to coordinate through a central control station, making solutions more scalable to large numbers and robust to individual robot or ground station failure. This raises new challenges in the design of algorithms that coordinate the UAVs throughout their deployment, from refuelling and loading, to in-air navigation, and delivery of their payload (goods, aid, extinguishing agent). These algorithms need to be developed in realistic digital twin environments that are just one-click away from testing on board the actual UAVs, seamlessly switching between simulation and reality. Beyond the software, swarm deployments require new UAV hardware allowing for inter-robot coordination, and communication. This proposal focusses on enabling swarm deployments of the ULTRA UAV through the development of a digital twin that allows for single-click transfer of swarm controllers from simulation to reality. Two use cases will be developed centered around humanitarian aid delivery, and forest fire mitigation, as we expect both applications to require large numbers of UAVs to have a meaningful impact. By the end of the project we will demonstrate a proof-of-concept flight with 5 UAVs. In parallel, we will also work on new hardware for the ULTRAs to allow for inter-robot communication essential for swarming. This proposal brings together Windracers, the makers of the ULTRA fixed wing 100kg payload UAV, with Distributed Avionics, experts in avionics, ground station, and flight control software for the ULTRAs, and University of Bristol with expertise in swarm engineering.

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ANGOKA LIMITED	UAS Authentication Service (UASAS)	£350,261	£245,183
CONNECTED PLACES CATAPULT		£62,505	£62,505
Cranfield University		£84,949	£84,949

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Project description - provided by applicants
The rapid emergence of new technologies is fostering a revolution in the flight sector which will drastically change the way people and goods are transported, with the potential to improve connectivity and alleviate environmental and societal issues. As the skies become crowded with manned and unmanned aircraft, new solutions are being developed to securely manage this increasingly complex air traffic. Unmanned Traffic Management (UTM) systems are emerging as the new paradigm for achieving that. UTM is a system of systems, made of a multitude of participants in the form of operators, service providers and public entities and authorities. High connectivity, automation and integration of such complex systems inevitably will open doors to a range of security threats. Although a user will be required by law to register and be uniquely identifiable within UTM, a malicious intruder could fool the system by impersonating an authorised user, potentially causing great damage. Being able to foil such attempts is of absolute importance for the safety and security of the integrated airspace and all its users. Angoka has built an expertise in securing vehicle communication in the automotive sector, through the introduction of a unique mechanism of hardware authentication. We believe that the technology can be adapted and transferred from Connected Autonomous Vehicles to Unmanned Air Systems (UAS), to make it impossible for attackers to forge their identity. Working with the Connected Places Catapult, Angoka will analyse the requirements for the integration of their solution into UTM. With the help of Cranfield University, the hardware unit will be interfaced to a drone for a real flight demonstration. As well as proving the robustness and resilience of the end-to-end authentication solution, we will also show that the trust can be seamlessly retained when crossing different domains serviced by different communication networks.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
TEKTOWR LTD	SMARTER - A 4D, Cloud-based Simulation-as-a-Service Digital Twin of the Combined ATM / UTM Airspace	£303,555	£212,488
DIGITAL CATAPULT		£129,830	£129,830
NPL MANAGEMENT LIMITED		£15,178	£15,178
SNOWFLAKE SOFTWARE LIMITED		£50,502	£25,251

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Project description - provided by applicants
SMARTER is a Four-Dimensional Digital Twin of the Combined ATM / UTM Airspace. Using novel machine learning / deep reinforcement learning techniques, SMARTER will address challenges arising from problem statement 2 of the Future Flight Challenge. SMARTER will: * Based on Massive Multiplayer Online Game (MMOG) technology, provide an innovative, collaborative, cloud-based Simulation-as-a-Service environment where several thousand aircraft (both traditional civil aircraft, military aircraft and UAVs) will be simulated based on both real-world data and simulated data. * Learn, infer and deduce the new rules needed to accommodate the safe _and_ efficient (both environmentally and commercially) management of the combined ATM and UTM traffic (both for non-segregated, lower airspace and en route traffic). These rules can then be used in support of the safety case for CAP670, CAP722, ED-109A, DO-178C compliance for both UAV operators and Air Navigation Service Providers (ANSPs) and facilitate global capacity management modelling and collaborative decision making. * Allow users (e.g. ANSPs) to test "what-if" scenarios including modelling sensor failures / low coverage regions, weather, population density, loss of control of the UAV, loss of communications, special use areas / danger areas. SMARTER will learn how each aircraft, the airspace and indeed the system of systems is required to react in order to both meet safety and performance KPIs. * Develop novel mathematical techniques to characterise the uncertainty associated with ascertain the single source of truth for the presented state of the airspace given the multiplicity of data inputs from sensors, measurements, radar (both primary and secondary surveillance), ADS-B (over satellite comms), etc all of which are at varying levels of data quality. * Develop next-generation, turn-key 4D visualization and user experience techniques with haptic controls to gamify the manipulation of the airspace - streaming from centralized, cloud-based servers to either standard PC, mobile device or 4D visualization devices (e.g. Occulus Rift, etc.). This facilitates rapid scenario testing. Users will be able to get an account, log-in and use the environment without purchasing any specialized equipment. * Since the environment is cloud-based, it will provide an on-demand collaborative decision making environment where multiple stakeholders can work together to form a consensus on capacity & separation management standards whilst respecting the commercial constraints of both small SMEs (e.g. UAV operators), ANSPs and large multinational OEMs. SMARTER will use emerging ATM data standards (such as WIXM / FIXM / AIXM) for seamless integration into ANSP operations. Furthermore, as well as being used to facilitate the development of the safe, efficient separation management rules, the simulation environment provided by SMARTER can be used to train UAV operators, air traffic controllers and even pilots.

Results of Competition: Future Flight Challenge Phase 2: Strand 1, Fast Track Development

Competition Code: 2004_ISCF_MMM_FUTUREFLIGHTCHALLENGE_FULLSTAGE_FASTTRACK_STR1

Total available funding is £34,000,000 over 2 strands

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
CITY SCIENCE CORPORATION LIMITED	Computational Rationality for Distributed Airborne Delivery Agents	£387,481	£271,237
University of Exeter		£86,675	£86,675

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
This project develops a system to integrate distributed airbourne delivery vehicles into an end-to-end customer delivery proposition. By doing this we will develop and demonstrate a detailed commercial aviation system model and AI capability building on the Alan Turing Institute's BlueBird family of avaition simulation tools. Our solution will be developed to accomodate fully electric and autonomous Unmanned Aerial Vehicles (UAVs) with a specific focus on deliveries. Our solution will build on consortium expertise within "Systemised Airspace Design" (SAD) to understand and evaluate future pre-set "three-dimensional networks" in the sky through which UAVs are expected to operate safely within urban environments. The system will combine future airbourne network representations with comprehensive multi-modal ground-based freight networks to provide optimal routing schedules across the full spectrum of future electric and sustainable delivery modes. As a result, the project will address the integration challenges of new air vehicles into both the aviation system and wider freight & logistics sector. With a focus on deliveries, the project will explore both optimal network designs and operational routing across these future networks. Using a multitude of simulations, accomodating the sizing and weight characteristics of deliveries and the operational performance constraints of UAVs we will create a system that can optimise deliveries considering the following factors: * Operational Cost * Time to serve (customers) * Energy Use (by fuel type and electrical network need) * Carbon Emissions and * Air Quality. As such the solution will be able to inform approaches to sustainable aviation and critical infrastructure gaps required to ensure sufficient renewable energy infrastructure to power these future systems. Detailed models of operational performance will also help explore new business models in sustainable logistics.

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MALLOY AERONAUTICS LIMITED	SHIMANO (System for High Integrity Monitoring of Advanced-Air-Mobility Network Operations)	£87,443	£61,210
CAMBRIDGE SENSORIIS LTD		£87,489	£61,242
MAKUTU DOT IO LIMITED		£87,598	£61,319
Oxfordshire County Council		£18,003	£18,003
R4DARTECH LTD		£87,513	£61,259
SATELLITE APPLICATIONS CATAPULT LIMITED		£131,954	£131,954

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Project description - provided by applicants

This project consists of a consortium of organisations with expertise in engineering, aviation, and business to provide a clear path for development, test and ultimately exploitation of Unmanned Aerial Vehicles (UAVs). The key areas expertise includes heavy lift UAV platforms, radar and radar identification technology, BVLOS communication, UTM data systems and integration, regulatory approval, and public exploitation.

This project is particularly innovative as it incorporates technology that has not yet been used on a wide-scale and aims to influence the UK CAA standards and pave the way for commercialisation of drone systems placing it at the heart of the expanding Future of Flight marketplace.

This project addresses the challenge of how truly resilient and cost-effective localised communication, navigation and surveillance is possible in high risk very low-level flight (VLLF) environments and how this localised information can augment existing air traffic management (ATM) and unmanned traffic management (UTM) technologies to provide enhanced situational awareness.

The potential value of the use of UAVs to provide such services has been demonstrated in controlled environments, however to realise the full societal impact of such concepts requires additional safety systems to be deployed and operated, such that the services may be available everywhere and to everyone in need.

The systems developed in this project will demonstrate resilient, accurate and safe operations of a UAV capable of delivery of medical equipment into complex high-risk environments. Trials of this system will help to establish wider commercial business applications for UAVs through demonstrating the significant benefits of localised situational awareness in critical scenarios such as take-off, landing and navigating in complex urban environments. Trials will also provide a platform to deliver and test operational requirements to identify the infrastructure and operational process requirements to provide an integrated ATM/UTM environment for future UAV operations and inform UK CAA of the standards that should be pursued and implemented to enable national exploitation of the technology.

The recent pandemic and similar crises have highlighted the need for better logistical support for rural communities, especially for the elderly and those requiring extra care, for instance to ensure rapid NHS testing of patient samples, and also for rapid delivery of critically urgent supplies. There is a requirement within the NHS to move test samples reliably between the location where they are taken and the laboratory. At present this is done by road, which has a heavy reliance on human time, environmental consequences due to carbon emissions and can be easily disrupted by external factors such as traffic, restrictions in movement or lack of infrastructure to obtain access to isolated locations. If a managed UAV flight capability were established this delivery time could be cut significantly. This could also apply to delivery of blood from central blood banks and even donor organs.

Establishing managed control of UAVs will also permit the adoption of the technology by the emergency services. In the event of a major incident in an urban area, road traffic can rapidly gridlock delaying the arrival of ambulances. Although motorcycle paramedics are now very common, they are a compromise between speed and equipment carried. Using a load carrying UAV allows additional medical supplies to be quickly delivered to a scene to allow motorcycle paramedics to treat a greater number of patients without expending their available supplies. An example is that additional solid-state oxygen generators could also be delivered.

In later stages of the Future of Flight Challenge, we plan to transition to BVLOS trials demonstrating a routine operational drone services in a safely coordinated environment on a regional basis in support of fully identified end use cases with validated robust business cases.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
THE LIGHT AIRCRAFT COMPANY LTD	Enabel: Enabling aircraft Electrification	£116,367	£81,457
CDO2 LIMITED		£116,793	£81,755
Cranfield University		£149,814	£149,814
FLYLIGHT AIRSPORTS LIMITED		£117,003	£81,902

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Project description - provided by applicants
Electric propulsion is an essential part of the future of aviation, as we aim to reduce greenhouse gas emissions and other pollutants, reduce airport noise, and reduce flying costs. This project will bring together two aircraft companies and a university who all want to deliver and exploit electric flight. Already the companies have aircraft, either now or in development, capable of taking electric propulsion. Motor technology is now good enough to build viable aircraft, and batteries are heading that way -- although there's still a lot of debate about batteries, versus hybrid configurations, versus fuel cells. All of these however require us to learn how to achieve and operate safe aircraft. To do that we need to build and fly three prototype aircraft, using these prototypes to develop best practices in design, flying, testing (both on the ground and in the air), and ultimately how to certify and integrate aircraft that can be used in the same way as current conventional aircraft. Additionally to that basic knowledge of how to operate, and train pilots and engineers to operate electric aircraft will be developed. We plan to do that by starting small -- with a basic single or 2-seat microlight aeroplane supplied by TLAC that will have a simple power system and fixed pitch propeller. The second stage will be a more complex 2-seat light aeroplane supplied by Flylight with a reconfigurable research (electrical and hybrid) power system and variable pitch propeller. This aeroplane we plan to certify developing and using airworthiness and flight test standards appropriate certified training aeroplanes. In parallel with these, we'll be developing the ability to simulate, test and optimise electric propulsion using the powerplant test facilities at Cranfield University, who will be working with all partners to ensure the rigour and portability of everybody's solutions as well as providing its own expertise in aircraft design, powerplant testing, and flight testing. We will also use Cranfield and Sywell airports to understand the necessary infrastructure for supporting electric flight.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
SNOWDONIA AEROSPACE LLP	Project "Gold Dragon" - airborne detect-and-avoid for BVLOS drones enabling integration with new aviation systems	£303,000	£212,100
SWIFTFLIGHT AVIONICS LIMITED		£196,999	£137,899

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Project description - provided by applicants
The primary objective for this project is to accelerate development and testing of a micro radar-based airborne detect-and-avoid solution for small/light drones enabling integration with new aviation systems. Our aim is to achieve approval for beyond visual line-of-sight (BVLOS) operations in non-segregated airspace by the end of Future Flight Challenge Phase 2 so we can contribute more widely to Phase 3 and also look to start commercial drone services. Snowdonia Aerospace will be partnered by SwiftFlight Avionics and we have significant recent BVLOS experience working together as a team. Snowdonia Aerospace and SwiftFlight Avionics have recently shown how satellite-enabled communication and navigation systems can contribute to a multiple redundant, fail-safe avionics architecture for a small drone that addresses many of the BVLOS issues required for regular and routine operation. The study concluded in a successful BVLOS demonstration in segregated airspace at the Snowdonia Aerospace Centre (SAC) in partnership with the Welsh Ambulance Service that showed proof-of-concept for delivery of a mini-defibrillator via drone to a remote/rural location that would be difficult to reach with an ambulance in a timely fashion. To address the additional surveillance requirements needed for operating in non-segregated airspace, we have further identified a micro detect-and-avoid radar that represents the state-of-the-art in small/light drone detect-and-avoid and testing either one in a UK environment and regulatory context will be a major innovation. We have adapted our avionics architecture to accommodate a radar and identified design options for a slightly larger twin-engine drone that will give us greater payload flexibility for the next phase of testing. The team will draw upon previous detect-and-avoid simulation data provided by the manufacturer and will conduct verification and validation flight testing at SAC, initially using the BVLOS Danger Area to ensure that testing can be conducted in a safe, controlled and operationally representative environment. SAC will also provide general aviation (GA) assets as "intruder" aircraft to test the detect-and-avoid capability. We have already built a successful relationship with the Welsh Ambulance Service via our recent demonstration activities and will continue to prioritise health services in remote and rural communities as part of this project along with the wider NHS Wales network. Flight testing in the operational environment provided at SAC will also allow us to involve other potential emergency response stakeholders - _e.g._ Police, Fire, Coastguard Search and Rescue, Mountain Rescue _etc_. - and we have already begun engagements to capture their key requirements.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
PETALITE LIMITED	Retroflight Alpha - A novel eVTOL charging infrastructure platform	£399,172	£279,420
RTS TECHNOLOGY SOLUTIONS LIMITED		£100,489	£70,342

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Project description - provided by applicants
The aim of this industrial research project, named Retroflight-Alpha is to develop the physical and digital infrastructure to support future flight objectives. This includes both a highly reliable 600kW charging capability utilising Petalite's 3-Phase SDC patent and Vanti's smart building operating system (Smart Core(tm)), required to serve electric vertical take-off and landing (eVTOL) aircraft in high density urban environments (HDUE). Ultimately reducing the associated high cost of ground works due to "peak loads" and traditional hardware reliability issues which would make these landing sites financially unviable. Without the right charging infrastructure in place eVTOLs cannot become a feasible form of transportation. Electric vertical take-off and landing (eVTOL) aircraft power demands create unique charging challenges: due to frequent short trips and limited time to charge between them. They will endure hundreds of charging cycles in their lifetime located in high density urban environments (HDUE) and require huge amounts of power and high reliability for vertical take-off and landing. Petalite have addressed the integration challenge of new air vehicles by partnering with Vanti, a Systems Integrator with deep experience in integrating proprietary technologies into wider building systems landscapes. At the anticipated power loads of eVTOL charging, wider building automation and systems orchestration are essential to ensure existing electrical supplies can be utilised but are simultaneously monitored to eliminate the risk of them being overloaded and users of buildings being disrupted. As well as commercial buildings other locations for this essential infrastructure will include repurposing the tops of car parks, existing helipads and even EV charging stations. To meet these unique charging demands, Petalite have invented a?patent pending charging?platform?for an innovative new way of charging "3-Phase SDC" Supercharging, with_?a true single stage topology, with 30-50% less components, higher reliability, longer working lifetime (up to 4x MTBF) compared to existing Full-Bridge topologies._ Petalite's Charging as a Service (CAS) business model offers 4 x ROI potential. Petalite's current system meets the battery charging standards for train, tram and buses, further development of the switching algorithm is needed to fully comply and communicate with eVTOLs. This is an evolution of a successful 1-phase SDC Innovate UK (IUK) project (2019) in the rail industry which will invent SDC systems in a laboratory environment and develop them (TRL4-6) to comply with eVTOL CCS standards. The modular design of the 3-Phase SDC will enable rapid growth and unlimited scalability across the eVTOL charging network nationally, while Vanti's open source and open protocol smart building operating system will enable site operators to manage peak energy consumption and minimise impact on existing electrical infrastructure, which is a crucial element of the eVTOL charging requirement.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
ELECTRIC AVIATION LIMITED	FUSE - Future Urban Simulation Environment	£275,543	£192,880
Cranfield University		£144,356	£144,356
GEOXPHERE LTD		£79,759	£55,831

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Project description - provided by applicants
Unmanned Air Vehicles (drones) offer a huge opportunity to add a new layer to every country's established transport infrastructure by providing delivery and transport services directly to the customer, amongst many other applications. This relieves pressure on road networks, which are already at full capacity in most urban areas. The implementation of such drone services in any town will require the active cooperation and involvement of both the Local Council and the residents. However, both these groups are likely to be highly resistant to the introduction of drone services with regards safety, privacy and noise (as well as the natural resistance to change). The FUSE project creates an Unmanned aircraft Traffic Management System (UTM) simulator. A "digital twin" built using the latest technologies, it blends aviation, gaming, simulation, and Geographic Information Systems to create a synthetic environment within which strategies, laws and platforms for electric aviation may be tested out. Such simulations can then be run using FUSE's inbuilt Unmanned Traffic Management simulator to test the co-ordination of all urban air traffic. Being built out of an already published gaming flight simulator, FUSE allows us to design from the ground up, the first 400' of urban airspace, tackling the concerns of Air-Space Regulators, Local Government and the public alike. The FUSE Project provides a synthetic environment through an immersive 3D simulation of a real airport, which will can be used by: * the Air Traffic Management, the UTM vendors and delivery companies to establish and test the implementation of the Local Authority preferred schemes of operation. This will require for instance the establishment of local depots (mobile, or on the edge of town) from which the drones can pick up their loads for the 'last-mile' delivery service. * the Air Traffic Management authorities to test the safety of the Unmanned Traffic Management services when considered in combination with other airspace users (police and ambulance helicopter services as well as normal aircraft operations). * the Drone Developers, Air Traffic Management and UTM vendors to establish and test drone air lanes as well as autonomous collision avoidance rules-of-the-road to allow drones to safely occupy the same airspace. * the Local Authority to develop schemes and supportive legislation such that drones may be limited to operations below 400' with no more than 200 sorties per day in a specific area and within the operating hours of 8am to 8pm. Drones may not operate below 300' over parks or gardens and wherever possible drones must follow the road network. Medical deliveries and blue light services will always take priority. * the Local Authority to conduct public consultations to demonstrate the effect of the proposed service from any geographical point in terms of noise and visual impact. The FUSE Project is innovative, as not only does it develop a UTM simulator, allowing for scenario planning and load testing of UTM systems, it also will bring the Local Authority and the residents into the picture, allowing them to help shape this new transport revolution that will be implemented in their area.

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This is likely to lead to much faster acceptance and adoption.

FUSE takes a "system-of-systems" approach to enable us to test UTM systems and run simulations that:

* Set flight levels and limits on operations.
* Balance commercial potential with environmental impact.
* Engage and take the public with us on this journey.
* Help develop legal model articles to regulate urban airspace.
* Publish operational routes from the Local Authority into the UTM system.

FUSE generates a UTM simulator with the ability to design strategies for Urban Airspace, allowing |Local Authorities to connect with the aviation regulators in a comprehensive and educated manner.

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3UG AUTONOMOUS SYSTEMS LIMITED	Synthetic EnvironmEnt Risk analytics for autonomous UAS (SEER)	£169,436	£118,605
CLAYTEX SERVICES LIMITED		£208,772	£146,140
University of Bath		£119,437	£119,437

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Project description - provided by applicants
This project will combine risk analytic methods with high-fidelity physics-realistic simulations to rigorously assess the first- and third-party risk associated with Unmanned Aircraft Systems (UAS) and Urban Air Mobility (UAM). The project-level outputs from phase 2 will be an online risk analytics tool and a realistic physics-based simulation environment for testing autonomous systems. These two technologies are enablers for the expansion of the UAS and UAM sectors.

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